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Rubellofomes cystidiatus and *Spongiporus floriformis* newly recorded for India

Vinjusha Nellipunath & T.K. Arun Kumar*

The Zamorin's Guruvayurappan College, Kerala 673014, India
* Correspondence to: *tkakumar@gmail.com*

Abstract—In an effort to document the macrofungi of Kerala state, India, we collected and identified two brown rot polypores, *Rubellofomes cystidiatus* and *Spongiporus floriformis*, which represent new records for India. Here we present taxonomic accounts of the two species.

Key words—biodiversity, brown rot, *Dacryobolaceae*, *Fomitopsidaceae*, *Polyporales*

Introduction

Rubellofomes B.K. Cui & al. (*Fomitopsidaceae*, *Polyporales*) was erected to accommodate two brown rot polypores, *Fomitopsis cystidiata* B.K. Cui & M.L. Han and *F. minutispora* Rajchenb. According to Han & al. (2016), these two species were distinct from other *Fomitopsis* species by their purple pink to pinkish brown context. *Rubellofomes* can be distinguished from the closely related *Niveoporofomes* B.K. Cui & al. by its orange brown to dark brown pileal surface, purple pink to light pinkish brown context, and cylindrical to ellipsoid basidiospores. *Niveoporofomes* species produce ivory white to pale ochraceous pileus surfaces, white to ochraceous context, and ovoid to broadly ellipsoid basidiospores (Han & al. 2016). *Ungulidaedalea* B.K. Cui & al., another closely related genus, is separated by its ungulate, fragile fruit bodies and septate skeletal hyphae (Han & al. 2016). *Rubellofomes* has been reported previously from Argentina and China.

Spongiporus Murrill (*Dacryobolaceae*, *Polyporales*) was established by Murrill (1905), with *S. leucospongia* (Cooke & Harkn.) Murrill as the type species. The genus accommodates brown rot species with a monomitic hyphal system (David 1980). *Spongiporus* representatives are characterized by an annual growth habit, effused reflexed to pileate basidiomata, a monomitic hyphal system with clamped generative hyphae, and hyaline, smooth, thin-walled, acyanophilous, inamyloid, allantoid to cylindrical basidiospores (Shen & al. 2019). *Spongiporus* is distributed in Asia, Europe, and North America (Murrill 1907, Ryvarden & Gilbertson 1994, Spirin & al. 2006). *Spongiporus* has been considered as a synonym of other two brown rot polypore genera, *Oligoporus* Bref. and *Postia* Fr., by different workers (Gilbertson & Ryvarden 1985, Ryvarden & Gilbertson 1994, Pildain & Rajchenberg 2013, Ryvarden & Melo 2014). According to Shen & al. (2019), *Oligoporus* basidiocarps are resupinate while *Spongiporus* produces effused reflexed to pileate basidiocarps. *Postia* species differ from *Spongiporus* by a universally solitary habit and narrower basidiospores (Shen & al. 2019). Pildain & Rajchenberg (2013) treat *Oligoporus* as a synonym of *Postia*. *Postia* species produce thin walled basidiospores and generative hyphae that are metachromatic in cresyl blue. *Oligoporus* representatives produce thick-walled cyanophilous spores and their hyphae are non-metachromatic in cresyl blue (Erkkilä & Niemelä 1986, Renvall 1992, Pildain & Rajchenberg 2013). Recent phylogenetic studies treat *Oligoporus*, *Postia*, and *Spongiporus* as independent genera (Ortiz-Santana & al. 2013, Binder & al. 2013, Cui & al. 2014, Shen & al. 2019). Seven species have been recognized in *Spongiporus* (He & al. 2019; www.indexfungorum.org).

Kerala state in India has a rich mycobiota, with a documented diversity of 148 polyporoid species (Adarsh & al. 2018). As part of studies on the polyporoid fungi of the region, two interesting species were encountered that were later found to represent new records for India. Here we present the taxonomic details of the two new polypore records.

Materials and methods

Fruitbodies were collected from forest areas of the Kerala region of Western Ghats in India during the monsoon seasons. Macroscopic characters of fresh specimens were recorded. Microscopic observations were made on materials stained using aqueous solutions of 3% phloxine and 1% congo red and mounted in 5% aqueous KOH. Reaction of the basidiospores on treatment with Melzer's reagent and cotton blue was noted. Twenty basidiospores from each specimen were measured for obtaining the spore dimensions, range of spore quotient (Q, length/width ratio), and its mean value (Q_m). All collections examined are deposited at the Zamorin's Guruvayurappan College Herbarium, Kozhikode, Kerala, India (ZGC).

Taxonomy

Rubellofomes cystidiatus (B.K. Cui & M.L. Han) B.K. Cui, M.L. Han & Y.C. Dai, Fungal Diversity 80: 366. 2016 FIG. 1A–C

BASIDIOMATA annual, medium sized, pileate, hard, woody, light weight, when dry. PILEUS 30–65 mm long, 14–20 mm thick, sessile, broadly attached, difficult to detach from the host, applanate to slightly irregular with minute ridges and grooves, almost semicircular, glabrous, azonate, purplish brown to cinnamon brown (browner on drying), turning brownish black in KOH. MARGIN even, round, sterile, orange yellow. HYMENOPHORE poroid, pale purplish brown, more brownish on drying. PORES large, 1–3 mm wide, narrow towards margin, angular, pore tubes 10–15 mm long, concolorous with the hymenophore. CONTEXT 3–5 mm thick, very pale pinkish brown, homogeneous. ODOUR not distinctive. SPORE PRINT not observed.

HYPHAL SYSTEM dimitic, generative hyphae septate, with clamp connections, slightly thick to thick walled, skeletal hyphae unbranched to slightly branched. PILEIPELLIS an agglutinated cutis, easily crushed in sections, pileipellis hyphae 2–3 µm wide, slightly thick walled, yellowish brown. PILEAL TRAMA interwoven, generative hyphae 2–3 µm wide, septate, hyaline, mostly thick walled, branched, clamp connections present. HYMENIAL TRAMA interwoven, generative hyphae 2–3 µm wide, septate, hyaline, slightly thick to thick walled, branched, clamp connections present and skeletal hyphae 2–5 µm wide, hyaline, simple to rarely branched, aseptate, thick walled (1 µm). Skeleto-ligative hyphae not observed. CYSTIDIA 31–42 × 4–6 µm, clavate to cylindrical, hyaline, thick walled (1 µm), encrusted. BASIDIA 26–32 × 3–4 µm, clavate, 2-sterigmate, with basal clamp connections. BASIDIOSPORES 5–8 × 2–3 µm, $Q = 3–4$, $Q_m = 3.4$, cylindrical, often slightly bent, smooth, thin walled, eguttulate, inamyloid in Melzer's reagent.

SPECIMEN EXAMINED: **INDIA**. **KERALA**: **Palakkad**, Silent Valley National Park, 11.0641°N 76.5378°E, on dead wood of unidentified tree, 14 January 2018, Vinjusha N. (ZGC VN667).

KNOWN DISTRIBUTION: China

COMMENTS: The present collection possesses slightly longer spores when compared with the original description of the material of *R. cystidiatus* ((4.8–)4.9–6.2(–6.5) × 2.0–2.8(–2.9) µm, Han & al. 2014). The pileus surface of *R. cystidiatus* was described as concentrically zonate (Han & al. 2014), but proper zonations or concentric rings were not observed in our collection. According to Han & al. (2014), the pore surface of *R. cystidiatus* is pale purple pink in fresh condition and turns clay buff to cinnamon brown on drying. However, a pinkish tint was absent in our collection and its more purplish to brownish shades may be because the specimen was collected in a more or less dried form.

Spongiporus floriformis (Quél.) Zmitr.,
Folia Cryptogam. Petropolitana 6: 90. 2018. FIG. 1D, E

BASIDIOMATA annual, small to medium, pileate, in clusters, slightly coriaceous and spongy when fresh, becoming hard on drying. PILEUS 15–30 mm long, 3–6 mm thick, laterally attached with a distinct region of attachment, rarely sessile, conchate, mostly flabelliform, sometimes semicircular, fruit bodies fused at the region of attachment, minutely pubescent to glabrous, cream white with pale brown zones when fresh, more brownish when mature, surface with concentric zones. MARGIN even to slightly wavy, incurved on drying, acute, sterile, concolor with the surface pileus. HYMENOPHORE poroid, creamish white, pale brown on bruising. PORES 6–8 per mm, absent near margin, angular to irregular, pore tubes 2–3 mm long, non-stratified, white when fresh, cream on bruising. CONTEXT 1–2 mm thick, white, homogenous. ODOR not distinctive. SPORE PRINT not observed.

HYPHAL SYSTEM monomitic, generative hyphae with clamp connections, thin to thick walled. PILEIPELLIS an irregular cutis, with scattered short erect agglutinated hyphal patches that are hyaline that are up to 20 µm long. PILEAL TRAMA interwoven, generative hyphae 2–5 µm wide, hyaline, branched, thin to mostly thick walled (1–2 µm), clamp connections frequent. HYMENIAL TRAMA interwoven, generative hyphae 2–4 µm wide, hyaline, branched, thin to mostly thick walled (1–2 µm), clamp connections frequent. CYSTIDIA and other sterile structures absent. BASIDIA 12–30 × 4–5 µm, clavate, 4-sterigmate, with basal clamp connections. BASIDIOSPORES 3–4 × 2–2.5 µm, $Q = 1.5–1.6$, $Q_m = 1.83$, subcylindric to cylindric, hyaline, guttulate, usually with one or two large guttules, thin walled, smooth, inamyloid in Melzer's reagent.

SPECIMEN EXAMINED: **INDIA. KERALA: Kottayam**, Vagamon, Pine valley, 9.6862°N 76.9052°E, on rotten wood of *Pinus* species, 25 October 2015, Vinjusha N. (ZGC VN258).

KNOWN DISTRIBUTION: Asia, northern to southern Europe, circumpolar in the boreal conifer zone.

COMMENTS: The Indian specimen resembles *Postia tephroleuca* (Fr.) Jülich, a species already reported from India (Ranadive 2013). However,

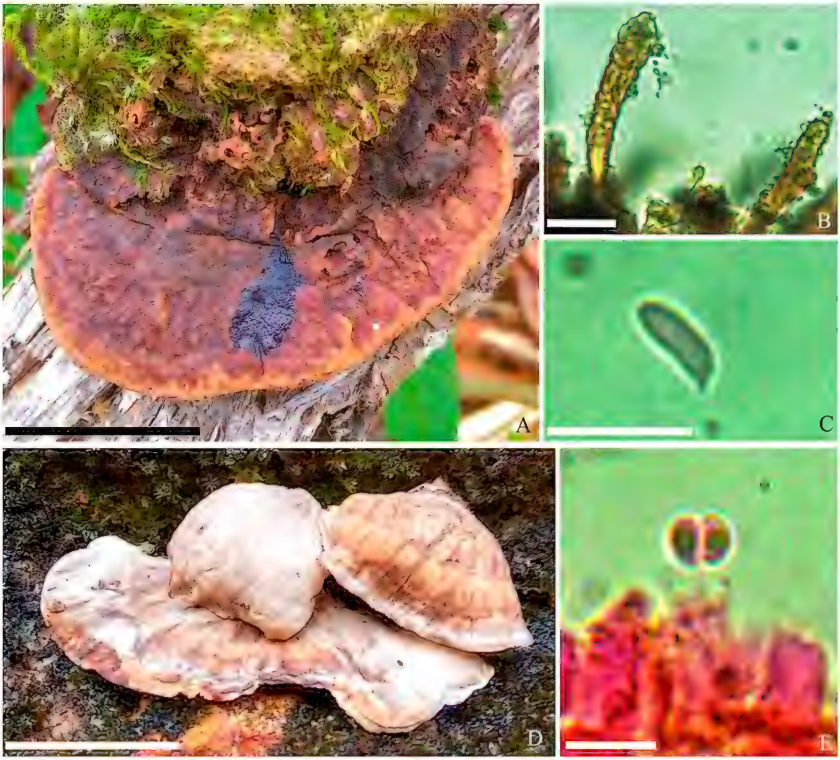

FIG. 1: *Rubellofomes cystidiatus* (ZGC VN667): A. Basidiomata; B. Encrusted cystidia; C. basidiospore. *Spongiporus floriformis* (ZGC VN258): D. Basidiomata; E. Basidia with attached basidiospores. Scale bars: A = 25 mm, B = 15 µm, C = 10 µm, D = 10 mm, E = 6 µm.

P. tephroleuca fruitbodies are always sessile whereas fruit bodies of our collection have a distinct point of attachment. Also, *P. tephroleuca* basidiospores are longer and narrower (4.5–6 × 1–1.5 µm) than those of our collection (3–4 × 2–2.5 µm). According to the description from the isotype by Lowe (1975), *S. floriformis* produces conchate to often spathulate pileus with a central stem-like point of attachment. While Ryvarden & Melo (2014) describe the same collection as petal-like, sessile, or effused reflexed. According to Lowe (1975), the fruitbody trama contains some gloeoplerous hyphae; however, we did not observe any hyphae with gloeoplerous contents.

Discussion

Rubellofomes comprises two species, *R. cystidiatus* and *R. minutisporus* (Rajchenb.) B.K. Cui & al. The presence of cystidia and larger spores distinguish *R. cystidiatus* from *R. minutisporus*. Except for the absence of distinct concentric zonations on the pileus and small variations in the pore surface colour and size of basidiospores, characters of our collection fit well with those in the original description of *R. cystidiatus* from South China (Han & al. 2014, as *Fomitopsis cystidiata*). Since then, the species has never been reported from elsewhere, and this is the first report of the species outside its type locality.

The Kerala collection of *Spongiporus floriformis* resembles *Postia tephroleuca*, except that *P. tephroleuca* has sessile fruit bodies and longer and narrower basidiospores. Possession of leptocystidia and amyloid tramal hyphae help separate *S. rhodophilus* Spirin & Zmitr. from our *Spongiporus* collection. Spirin & al. (2006) reported conidial cells on the pileus of *S. floriformis,* but we did not find any conidia in our collections. Reported hosts of *S. floriformis* are *Abies*, *Cedrus*, *Crataegus*, *Cupressus*, *Larix*, *Picea*, and *Pinus* (Ryvarden & Melo 2014). The collection from Kerala was obtained from dead wood of *Pinus*.

Rubellofomes cystidiatus and *Spongiporus floriformis* are new records for the mycobiota in India.

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